A REVIEW OF ISCHNOCHITON (HAPLOPLAX) SMARAGDINUS, ANGAS, 1867, AND ITS CONGENERS, TOGETHER WITH THE DESCRIPTION OF TWO NEW CHITONS FROM PAPUA.

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Plates XVI. to XIX.

Before dealing with the *Haploplax* from Papua, for which, as well as other forms dealt with later in this paper, my thanks are due to my friend Dr. W. G. Torr, it became imperative to settle the question as to whether the shell described by Bednall and Matthews, under the name *Ischnochiton resplendens* (Proc. Mal. Soc., vol. vii., pt. 2, June, 1906), is distinct from the Sydney shell, which was described by Angas under the name *Lophyrus smaragidinus* (Proc. Zoolog. Soc., 1867, p. 115, t. 13, f. 28; *l.c.*, p. 222). Torr, in his paper on Western Australian Chitons, in 1911, treated it as a distinct species, but in his paper of the next year, considered it a colour variety of *I. smaragdinus*. Up to the present time no one has published the results of any careful examination. A reference to Bednall and Matthews' paper *(l.c.)* will show that they considered the common *Haploplax* in South Australia conspecific with the Sydney shell, and separated their species purely on colour characters and size.

While colour markings may, in some measure, be distinctive of geographic races, we are not justified in recognizing these features, unsupported by more important characters, as having any specific value.

A comparison of the extensive series in my collection from Port Jackson, New South Wales; Port Arthur and Frederick Henry Bay, south-eastern Tasmania; Penguin, north-western Tasmania; South Australia; and from Yallingup, in Western Australia, reveals some very interesting features.

Size.—In respect to size, the Sydney shell averages decidedly smaller than those from the other States; the largest from there, on my card, is 16×9 mm. Those from north-western Tasmania and South Australia are very similar in size, the largest on my cards measuring 23×13 and 20×11½ mm., respectively. In Frederick Henry Bay, in south-eastern Tasmania, and Yallingup, Western Australia, we find giant races measuring 30×17½ and 29×17 mm., respectively.

Colour markings.—A very striking colour variety occurs at Port Jackson, one in which the end valves are dark and the rest light, cream, white, or grey; and a similar varient also occurs in south-eastern Tasmania, but I am not aware of its occurring in any of the other localities named.

The beautifully-streaked form described by Bednall and Matthews under the name *H. resplendens,* seems only to occur in Victoria, South Australia, and Western Australia. The cruciform variety in all its colour variations is common to all the localities except Western Australia.

In all the localities except this latter there exists a great variation both in colour and pattern, but at Yallingup, on the west coast of the latter State, all the specimens taken are of one colour pattern, a dark variety of the streaked form named *H. resplendens.*

Dr. Torr advises me that he also only collected this form in the same locality, and the few specimens he collected on the south coast, at Albany, were similar.

Inside and form.—After disarticulating a series from the various localities, the shape and carination of the valves, the position of the mucro on the tail valve, and the shape of the sutural laminae were so similar as to need no special comment. The variation of the number of slits in the insertion plates of the two end valves is interesting but not conclusive; thus Sydney specimens showed 12-12 slits, Port Arthur 11-12, Penguin 11-12, Marino (South Australia) 10-10, Yallingup 10-9. But another from Marino showed several additional, crowded slits in the tail valve, while still maintaining the 10 in the anterior; also a large shell from Yallingup has 10-12 slits. The most that can be said is that the South Australian and the Western Australian shells both seem, when of an equal size, to have a fewer number of slits than is the case with the eastern forms.

Sculpture compared.—The Sydney shell is decorated with very shallow subtriangular pits, which are more evident in the pleural area than in the lateral; concentric growth sulci are present in the lateral areas and are continued across the pleural. The girdle is covered with polished, smooth, pebble-like scales, features that are common to the whole series referred to above. The specimens from south-eastern Tasmania are generally similar in sculpture, which is very shallow, the pitting in the pleural area is to some extent arranged in longitudinal rows, the shallow ridge between these when seen under 65 magnifications, and laterally lighted, gives the effect of longitudinal ribbing, a feature I have not noticed in the shells from Sydney, the growth sulci are present in the lateral areas but only to a very limited degree in the pleural; a juvenile from this locality, 10 mm. in length, is completely smooth except for growth sulci. The specimens from north-western Tasmania are very similar, although, possibly, the lateral area is smoother, the inner half often absolutely smooth, and the pitting in the pleural area is circular and more evenly distributed than the preceding, but still very shallow.

All the South Australian shells, whether they be the variety with delicate streaking, described as *H. resplendens,* or of any other pattern, show a distinctly deeper pitting, which is much more regular than any of the preceding, the pits in a few places are confluent, but on the whole are so regular that the ridges between, under a high power, resemble a network or honey-comb. In the shells from Yallingup, in Western Australia, this regular honey-comb pitting reaches its maximum development. In the pleural area, in both younger and older shells, the pitting is regular, deep, circular, or hexagonal, and the same character is preserved in the lateral areas, except that it is there a little confused by a limited amount of radial pitting. While some wavy growth sulci cross the lateral areas and are to a small degree seen in the pleural, they are not in evidence to anything like the extent that they are in the far-eastern forms. The scales in these western specimens are larger than in any of the preceding, but this may be partly due to their much larger size.

In conclusion.—Radial ribbing or shallow grooving in the two end valves and lateral areas is present in all Yallingup specimens, and in all medium to large specimens from South Australia, but is absent in those from New South Wales and Tasmania. I have one partial exception from the latter State, in which two of the valves are abnormal; in these, this feature is merely suggested.

The pitting in the eastern shells is more shallow, and in some parts absent altogether, and the juvenile specimens are often quite smooth, which is never the case with the western forms.

I therefore propose to recognize *H. resplendens*, of Bednall and Matthews, as a subspecies, including under this name all the varieties occurring in South Australian waters. One hardly knows what to do with the Yallingup form. It certainly exhibits a wonderful constancy in colour and pattern, and shows the distinctive sculpture of the South Australian shell in its most marked degree;

in addition, it is an exceptionally large race with larger scales than any from the other States, but in face of the limited material available it seems best, at any rate for the present, to distinguish it only by a varietal name. I therefore propose to recognize it as a variety of *H. resplendens* under the name *westernensis*.

It seems probable that the western form is the progenitor of the South Australian shell, and that the two forms, the eastern and the western, may have become intermixed in the State of Victoria, since the breaking down of the Bassian Isthmus. It is interesting to note that the megalapores, or terminals, of the sensory fibres are seen in these forms as black dots in the centres of each pit, in the shell sculpture.

Ischnochiton (Haploplax) lentiginosus, Sowerby, 1840.

(*Chiton lentiginosus,* Sow., Mag. Nat. Hist. Charlsworth, iv., (N.S.), p. 293, June, 1840; *Chiton adelaidensis,* Reeve, Conch. Icon., t. 191, f. 123, May, 1847.)

The following is the original description by Sowerby of a specimen from Newcastle, New South Wales:—"Shell oval, carinated, smooth; back elevated, lateral areas inconspicuous. Colour tawny-brown, ornamented with round blue spots. Margin minutely scaly; length, 15×9 mm."

As compared with *I. smaragdinus* or *I. resplendens*, this species is normally broader. The largest I collected at Bulli, in 1915, measures 16×11 mm. The "round blue spots" seem consistently present on all specimens, but in some the spots coalesce, forming blotches. The end valves and the lateral areas show shallow radial ribbing, which is broken, especially so in the lateral areas, by concentric growth sulci.

The median areas and the rest of the shell, in a less degree, are decorated with minute granules which are somewhat confused in their distribution.

While in the British Museum, last June, I was able to examine the types of Australian Polyplacophora in that collection, and my acknowledgments are due to Mr. Tom Iredale for much help in connection therewith. Together we examined Reeve's *Chiton adelaidensis*. My notes are as follows:—"This is *Haploplax lentiginosus,* Sowerby, without the blue spots, the whole being dirty white in colour. The scales are larger than *H. resplendens,* except the specimens from Yallingup, but are similar to *H. lentiginosus*. There is no doubt in my mind that Reeve's locality of Port Adelaide is quite a mistake. I have never taken this species in South Australia, though Mr. Iredale informed me that he had some that were alleged to have been taken by Mr. E. H. V. Matthews, near Second Valley, in this State. It will be seen that Sowerby's name antedates that of Reeve's by seven years.

Papuan Chitons.

I am indebted to my friend Dr. W. G. Torr for the opportunity of examining and describing a small collection of Chitons made by the Rev. R. Andrew, in Papua.

Acanthopleura spinigera, Sowerby, 1840.

(*Chiton spiniger*, Sow., Mag. Nat. Hist., 1840, p. 287.)

There are in the collection three large eroded specimens from Normanby Island, Papua, and one large and two juvenile specimens, in perfect order, from Misima, Papua. I do not consider these conspecific with the Australian *A. gemmata,* Blainville, for in addition to the more granulose character of the sculpture the Papuan shells have much longer, more slender, and curved spicules on the girdle. I consider them conspecific with the shell from the west coast of Sumatra referred to in my paper (Jour. and Proc. Roy. Soc. W. Austr., vol. viii., p. 31) under the name given above. The spicules on the Papuan specimens are considerably more slender and curved than the Sumatra specimen, and may, of course, be a distinct race.

Ischnoradsia papuaensis, n. sp

General appearance.—Broad, end valves equal in size and as well as the lateral areas radially ribbed, lateral areas raised, a minute granulose pattern covering the whole shell. Girdle scales large, pebbly, outer half keeled and pointed, inner half triangular and imbricating.

Colour.—Pale or worn valves are Light Greenish-Olive streaked with Mikado-Brown (Ridgway's Colour Standards, pls. xlvi. and xxix.), with often dark dorsal area and several dark spots on the posterior margin; the dark-coloured valves are green on the dorsal and lateral areas, merging into dark olive-brown towards the posterior margin.

Inside of shell.—Light greenish-olive merging into darker green, highly polished; in the median valves the sutural laminae, shallow, mostly bowed inwards in the centre. The tegmentum is infolded from the posterior margin, slits 1-1, and in one valve 2-1; the slit ray forms a very deep sinus, with highly-thickened walls, teeth of the insertion plates sharp, slightly grooved on the inside, eaves solid, articulamentum protrudes beyond the tegmentum; anterior valve 13 slits, posterior 18, sutural laminae with broad sinus similar to the median valves.

Anterior valve.—This valve is uniformly very minutely decussate; while in juvenile shells little other sculpture is to be seen. At an early stage they develop a series of flat, shallow, radial ribs, which are very broken, often continuing for some distance and then dying away, others being intercalated and taking their place; this gives the valve the appearance of being covered with dashes.

Posterior valve.—Broad and flat, mucro ill-defined, anterior of centre. The anterior margin of the tegmentum is bowed forward, the portion of valve in front of the mucro is very short longitudinally, and is decussated in a similar manner to the pleural areas of the median valves. The portion behind the mucro occupies nearly three-quarters of the valve, and is minutely decussate throughout; but, in addition, half-way down, the valve commences a series of broken, intercalated, radial ribs, similar in character to the anterior valve.

Median valves.—In the dorsal area the apex is smooth, then becoming grooved, with very minute, somewhat irregular, longitudinal grooving, this again changing, as the anterior margin is approached, into a decussated pattern, composed of evenly-distributed, minute granules. In the pleural area the upper part is longitudinally striate, similar to the dorsal, but rapidly becoming granulose. The lateral area is raised, with broad, shallow, radial ribs. On the valve before me I count 8, the sulci between are much narrower than the ribs. The whole area is decorated with minute granules like the rest of the shell. It will be seen that juvenile shells will show no radial ribbing at all, that feature being a later development.

Girdle.—The girdle is indistinctly banded with brown and light bands. The scales on the lighter portions are dark on the lower or outer half and light only on the upper, nearest the shell. The scales are quite characteristic of this genus, being large, subcarinated or keeled on the outer half, giving the appearance of being pointed, the upper half of each scale is subtriangular, flattened, and imbricating; the surface of the scale is not strictly smooth.

Measurements.—A somewhat damaged specimen measures 20×13 mm. The tegmentum only, of valves of type: anterior, 5×10; posterior, $5\frac{1}{2}\times10$; median, $3\frac{1}{2}\times12\frac{1}{2}$ mm.

Habitat.—Normanby Island, Papua.

Remarks.—I have placed this species under the genus *Ischnoradsia* because its scales are quite characteristic of members of that genus. But one was surprised to find only one slit in most of the median insertion plates, one valve only,

having two well-defined slits on one side, suggesting the possibility of specimens being found with two slits, which is usual in this genus. I note a Japanese species, *I. albrechti,* Schrenck, varies from one to three.

Ischnochiton (Haploplax) misimaensis, n. sp.

General appearance.—Elliptical, almost evenly arched, not carinated, shallow radial ribs in lateral areas and end valves; girdle clothed with polished, pebble-like scales, all of which are dark on the lower or outer side, but those in the light bands are transparent on the upperside.

Colour.—The ground colour of the upperside is Tea-Green, thickly covered with streaks and broad dashes of Mikado-Brown (Ridgway's Colour Standards, pls. xlvii. and xxix.).

Inside.—Greyish-green, very similar to the upperside, anterior valve with 13 slits in the insertion plate, irregularly placed, posterior 15 slits, sutural laminae shallow, anterior edge parallel with the tegmentum, sinus broad; median valves have 1-1 slit, sutural laminae somewhat rounded and rather large in proportion, sinus between very broad, insertion plate teeth sharp and the slits deep.

Anterior valve.—Raised, slope convex, shallow ribbing being distinguishable towards the margin, which is slightly crenate, the whole surface is decussated with minute, evenly-spaced granules. In the larger specimen it can be clearly seen that these granules are arranged in narrow, radial rows, about three of these forming the wider, flat, radial ribs, of which there are over 50 in each end valve.

Posterior valve.—Mucro a little anterior of middle, but little raised; the anterior portion occupies barely one-third of the valve, and the posterior two-thirds is defined by being raised slightly, thereby forming a diagonal ridge; the sculpture of the anterior portion is similar to the pleural areas of the median valves; the posterior two-thirds is similarly sculptured, but has, in addition, towards the outer margin, a suggestion of radial ribbing, but this in the type is so shallow as to be hardly discernible; several shallow-growth sulci are also present.

Median valves.—Evenly arched, not carinated, the dorsal area not defined, the combined dorsal and pleural areas are decussate with evenly-distributed, minute granules; several growth sulci are continued from the lateral areas, across the pleural area. The lateral areas are raised and well defined, covered with granules similar to the rest of the shell, but, in addition, crossed by two deep growth sulci and several minor ones; incipient, broad, radial sulci can be seen if the valve is held at a right angle. The large but crushed specimen *in situ* on a black stone measuring $15\frac{1}{2} \times 11$ mm. has five or six well-defined, flat, radial ribs in this area, where they are two or three times as broad as is the case in the end valves; they are noticeable, even without the aid of a pocket lens.

Girdle.—The girdle is broad banded, clothed with rather large, imbricating, polished scales, which are blackish in the dark bands and opalescent above and black below, on the outer side, in the lighter ones; this rather unusual feature is common to all the six specimens in the collection. The scales are polished, and under 65 mag. those nearest the shell are distinctly striate; the larger scales in the centre of the girdle are, under this power, partially striate, the surface of the scales is slightly rough, a subgranulose character that is not visible under a pocket lens. In *H. lentiginosus* the surface of the scales is smooth, although those immediately next the shell show some striae.

In *H. lentiginosus* the upper margin of the scales is evenly rounded, whereas in the species under review it is subtriangular. In the large damaged specimen before referred to there is a well-defined, short, girdle fringe; in *H. lentiginosus* in one or two specimens I can detect a less-developed fringe.

Measurements.—The type was not measured before disarticulation, but the largest one on the stone is $15\frac{1}{2}\times11$ mm., the next in size 15×9 mm., so probably the first-named is a little widened by crushing.

Habitat.—All the specimens are from Misima, Papua.

Remarks.—Although in outward appearance this species reminds one of *H. resplendens*, the sculpture being granulose instead of pitted, the more ribbed character of the end valves and the lateral areas, and the special scale features, easily separate it. It is separated from *H. lentiginosus,* to which species it is more nearly allied, by its much more regular granulose sculpture, different scale features, and absence of blue dots and its lack of carination, this last feature also separating it from all the races of *smaragdinus.*

In conclusion.—There is every probability that this *Haploplax* also occurs in North Queensland, and it is more than likely that the specimens collected at Port Molle, in that State, by Coppinger, and described by E. A. Smith (Zool., H.M.S. Alert, p. 79, 1884) as conspecific with *C. adelaidensis* of Reeve, are really this species, for his description well fits them. There is also just a possibility that Reeve's *C. adelaidensis* may have come from one of these northern localities, and, after all, not be conspecific with *H. lentiginosus,* to which species Mr. Iredale and the writer referred it in their examination of the type in the British Museum, with aid of pocket lens only.

For description of Plates see pp. 242 and 243.